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Professor Joshua Lederberg
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Dear Josh,

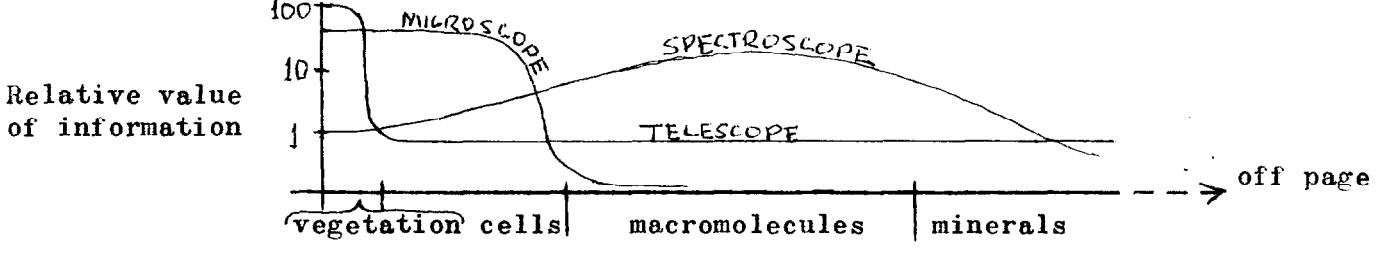
You will have no trouble exciting my interest in this ambitious mission, even if it means giving up my bedtime reading. But before I work up an enthusiasm for technical problems of tape-fed TV microscopes I would like to hear some strategic arguments.

In my present state of ignorance about the environments of Mars and Venus I am inclined to think that using only a fixed magnification microscope would be pursuing a rather specialized tack at the expense of leaving other reasonable situations unexplored. What I would like to see are your hunches on the relative probabilities of the conceivable environments on the planets, and your relative payoff values for receiving various types of information from the soft landing.

I shall expand my ignorance more specifically: let's give Nature just three strategies (1) no life, (2) single cells, (3) vegetation; and we shall give NASA only three, exploration with (1) microscope, (2) telescope, (3) spectroscope. The way I feel tonight, I would make my payoff matrix something like this:

		Nature's strategy		
		no life	single cells	vegetation
NASA strategy	microscope	lower	highest	high
	telescope	low	low	higher
	spectroscope	high	medium	medium

This representation, though probably better than nothing, leaves out two important considerations, first, the relative probabilities of Nature's strategies, and second, the different operational characteristics of the sensors. The latter can be measured in the lab, the former is not my field. Suppose you try making a graph like this:



Nature's strategy where relative probability is represented by length of intervals.

These curves and intervals are probably way off, but I hope you get the idea. If you can make any sort of reasonable guesses for such a graph then the optimal sensor system will practically assemble itself. At least we will have a criterion of success in our design.

In practice, after we superimpose the operational characteristics of the different instruments, we can then say what fraction of the total channel capacity should show micrographs, what fraction should show landscapes, and what fraction will represent absorption curves.

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Now I have made the assumption that the weight of the actual sensors is negligible compared to the common landing platform, power supply, communication system, and specimen gathering mechanism for the microscope and spectroscope. I think this is reasonable. If you have the complete microscope system, then all you need for a telescope is a small scanning periscope, a lens, and a shutter, plus an extra switch or two in the electronics. Similarly, I think a useful IR and/or visible spectroscope could be squeezed into a few dozen cubic cm. In any case the extra weight problem doesn't change the strategy argument. There is no reason to use a different strategy equivalent for weight distribution than for channel capacity distribution.

This brings up another possibility which I haven't thought about. Can you think of simple criteria whereby this robot sensing system could decide for itself how to distribute its channel capacity between instruments after it arrives and has a chance to look around?

Well, you can see that your letter has served its purpose. I don't know much about commercial TV microscopes, but I doubt if there is one at Stanford. The specimen gathering bothers me much more than the optical systems. To begin with, I think I would hire a good instrument or model maker to build some actual mechanisms you can try out in your backyard. One possibility I happen to think of is the excellent staff at the California Academy of Sciences who built the Morrison Planatarium from the ground up. If you want to make some contact with them before I return, ask Kirkpatrick to introduce you.

I shall continue to dwell on this problem enough so that when I return I may be of some use.

Sincerely yours,

Howard

Howard H. Pattee